Research Note 85-6

APPLICABILITY OF LOW-COST VIDEO TRAINING
TO VARIOUS U.S. ARMY WEAPONS

AD-A149 602

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A prototype simulator, labeled MACS (Multipurpose Arcade Combat Simulator) using an inexpensive microcomputer, light pen attached to the weapon, and a video monitor, has been developed by the Army Research Institute for the M16 rifle and the Viper light antitank weapon. This investigation produced a list of representative U.S. Army weapons which were rank ordered in terms of their suitability for MACS-type training. A two-stage process was used. In Stage 1, a long list of potential weapons was narrowed down to a shorter list of

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Abstract (cont'd)

representative U.S. Army weapons using a number of objective criteria. In Stage 2, the weapons from Stage 1 were rank ordered for suitability on the basis of three objective criteria (number of hours of training in current basic training, cost of ammunition, and number of weapons in the current Infantry Table of Organziation and Equipment), and one subjective criterion (opinions of trainers and MACS developers about the feasibility of adapting MACS to a given weapon). The following weapons were identified (listed in the order of suitability): (1) M16A1/A2 Rifle, (2) M72A2 Light Antitank Weapon (LAW), (3) M203 Grenade Launcher, (4) M60 Machinegun, (5) Dragon, (6) TOW, (7) .45 Caliber Pistol, (8) M249 Squad Automatic Weapon (SAW), (9) M202A1 FLASH, and (10) .50 Caliber Machinegun.

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APPLICABILITY OF LOW-COST VIDEO TRAINING TO VARIOUS U.S. ARMY WEAPONS

EXECUTIVE SUMMARY

Requirement:

A prototype part-task simulator, labeled MACS (Multipurpose Arcade Combat Simulator), using an inexpensive microcomputer, light pen attached to the weapon, and a video monitor, has been developed by the Army Research Institute for the M16 Rifle and the Viper light antitank weapon. The simulator/trainer is multipurpose in that different weapons can be "plugged into" the system. The purpose of this investigation was to provide a list of representative weapons rank ordered in terms of their suitability for low-cost, microcomputer-based, video simulation/training.

Procedure:

The production of the rank-ordered list involved a two-stage process. In the first stage, a list of U.S. Army weapons was compiled and then sorted using a decision tree that operationally defined "representative U.S. Army weapon." The product of this sort was a limited list of the most likely candidates for MACS-type simulation.

In the second stage, four criteria were chosen to rate the weapons that survived the sort in Stage 1: (1) number of hours spent training on that weapon in OSUT (One Station Unit Training), (2) cost of the ammunition, (3) density of the weapon in the infantry , and (4) the feasibility and desirability of creating a MACS application for that weapon. Criteria 1-3 were determined from existing objective information. In order to determine values for the fourth criterion, a structured interview was developed and administered to subject matter experts (SMEs) who were asked to rate the appropriateness of MACS-type training for the different weapons. In addition, the designers of MACS provided input about the feasibility of the various applications. The interviews also provided guidelines for deciding which training components were important for a particular weapon, and the importance of simulating various firing characteristics of the weapons. Finally, a literature review was conducted to determine whether any MACS-type devices already exist.

Findings:

The following weapons were found to be the most suitable for MACS-type simulation/training (from the most to the least suitable): (1)M16A1/A2 Rifle, (2) M72A2 Light Antitank Weapon (LAW), (3) M203 Grenade Launcher, (4) M60 Machinegun, (5) Dragon, (6) TOW, (7) .45 Caliber Pistol, (8) M249 Squad Automatic Weapon (SAW), (9) M202A1 FLASH, and (10) .50 Caliber Machinegun. The search for information on currently available simulators revealed several very expensive ones, but none in the price range of MACS ($3,000-$6,000).

Utilization of Findings:

This report provides objective criteria for identifying candidate weapons and rating the appropriateness of using a low-cost, microcomputer-based simulator/trainer for training on those weapons. On the basis of the results of this report, MACS applications will be developed for the top three priority weapons and subsequently tested for training effectiveness. If they prove successful, more weapons will be considered.

APPLICABILITY OF LOW-COST VIDEO TRAINING TO VARIOUS U.S. ARMY WEAPONS

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APPLICABILITY OF LOW-COST VIDEO TRAINING
TO VARIOUS U.S. Army WEAPONS

INTRODUCTION

The purpose of this report is to provide a list of weapons rank ordered in terms of their suitability for microcomputer-based video training/ simulation. A prototype part-task simulator/trainer, named MACS (Multipurpose Arcade Combat Simulator), has been developed by the Army Research Institute for the M16 Rifle and the Viper light antitank weapon (see Schroeder, 1983). The trainer is multipurpose in that different weapons can be "plugged into" the system. That is, the light pen sensing device can be removed easily from one weapon and attached to another weapon, and the computer software can be quickly changed to provide appropriate targets, ballistics, etc.

Although MACS is potentially quite versatile, it is clear that some weapons would make better candidates than others for MACS-type training. Therefore, objective criteria were developed to identify and rate the appropriateness of the candidate U.S. Army weapons. The main end product of this decision process was a list of weapons which were rank ordered in terms of their suitability for MACS-type training. Another product was detailed information from subject matter experts about the importance and difficulty in training different components for the various U.S. weapons.

METHOD

The production of the rank-ordered list involved a two-stage process: (1) identification of representative U.S. Army weapons for possible consideration and (2) rating the weapons according to their suitability for MACS-type training. In the first stage, a list of weapons was compiled using Ludvigsen (1982) as a primary reference source. This initial list is shown in Table 1. Objective criteria were then developed to operationally define "representative," that is, to narrow the initial list to include only those weapons most typical of the U.S. Army. The criteria selected for this purpose included: (1) whether the weapon was established, new, or a replacement; (2) whether there was a prototype available; (3) whether the weapon had been formally adopted; (4) whether the weapon was currently in the Army inventory; (5) whether the weapon was in the current infantry TO&E (Table of Organization and Equipment); (6) whether it was being phased out; and (7) whether it was in the Mechanized Infantry TO&E. To survive the first sort, a given weapon had to make it through the decision tree shown in Figure 1. More specifically, a given weapon had to be: (1) an established weapon, (2) in the Army inventory, (3) in the infantry TO&E, (4) not in the process of being phased out, and (5) in the Mechanized Infantry TO&E.

The second stage in generating the rank-ordered list was to evaluate the weapons surviving the sort routine in Figure 1 on their suitability for MACS-type training. Four criteria were selected to accomplish the ranking: (1) the number of hours spent training that weapon in the current OSUT (One Station Unit Training), (2) the price of the ammunition (per round), (3) the density of the weapon in terms of TO&E allotment, and (4) the feasibility of successfully adapting the MACS system to that weapon system in a way that would produce a significant training contribution.

Table 1

U.S. Army Weapons

Small Arms

M16A1/A2 5.56mm Rifle

Close-Assault Weapon System
  (CAWS)

M14 7.62mm Rifle

M21 7.62mm Sniper Rifle

M3A1 .45 Caliber Submachinegun

M1911A1 .45 Caliber Pistol

XM177E2 Carbine

Bradley Infantry Fighting Vehicle

M242 25mm (Bushmaster)

M231 Firing Port Weapon

Mortars

M224 60mm Lightweight Company
  Mortar

M29A1 81mm Mortar

XM252 81mm Mortar

M30 4.2 in. Heavy Mortar

Machineguns

M60 7.62mm General Purpose Machinegun
M249 5.56mm Squad Automatic Weapon
  (SAW)
M2HB .50 Caliber Heavy Machinegun
MK19 40mm (Grenade) Machinegun
General-Purpose Heavy Machinegun
  (GPHMG) Dover Devil

Launchers

M203 40mm Grenade Launcher
M79 40mm Grenade Launcher
M202A1 66mm Incendiary Rocket
  Launcher (FLASH)

Antitank Weapons

TOW Heavy Antitank Missile
TOW 2 Heavy Antitank Missile
M40A2 106mm Recoilless Rifle
M47 Dragon Medium Antitank Missile
Rattler Man-Portable Antitank
  Weapon
Tankbreaker Antitank Missile
M67 90mm Recoilless Rifle
M72A2 66mm Light Antitank Weapon
  (LAW)
Viper Light Antitank Weapon

MOUT Weapons

Rifleman's Assault Weapon (RAW)
  140mm
Special Hard-Target Assault Weapon
  LAW (SHAWL)

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NEW or REPLACEMENT?

YES

NO

PROTOTYPE
AVAILABLE?

IN ARMY
INVENTORY?

YES   NO

YES   NO

ADOPTED?   OUT

IN INFANTRY
T O & E?

OUT

YES   NO

YES   NO

GOOD   OUT
CANDIDATE,
BUT FURTHER
ANALYSIS
POSTPONED
UNTIL FUTURE
DATE

BEING
PHASED
OUT?

OUT

YES   NO

OUT   IN MECH INF
T O & E?

NO   YES

OUT   SUCCESSFULLY
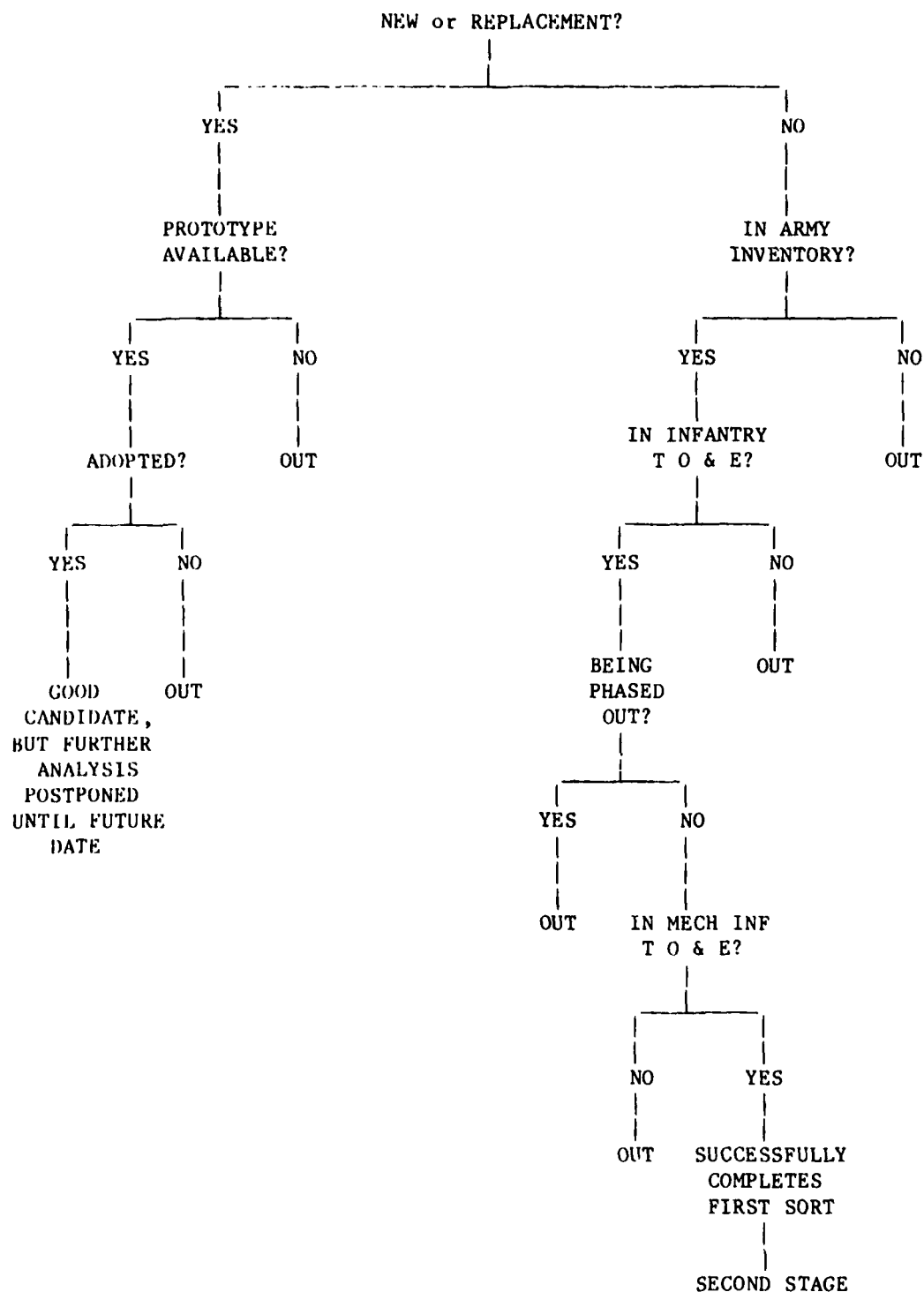COMPLETES
FIRST SORT

SECOND STAGE

Figure 1. Decision tree for determining representative infantry
weapon systems.

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The first criterion was the number of hours spent training on each of the weapons in OSUT. These numbers were obtained from the current OSUT POI (Program of Instruction). To satisfy the second criterion, ammunition costs were obtained from the ammunition price list for 1984 issued by TRADOC (Training and Doctrine Command). The third criterion was the number of weapons currently in the infantry. To determine approximate densities of the weapons within the infantry, the Mechanized Infantry TO&E at the battalion level was chosen. This choice was based on the assumption that the Mechanized Infantry Battalion is representative of infantry units. A Mechanized Infantry Battalion is organized in one of two ways: with or without the Bradley Infantry Fighting Vehicle (BIFV). Therefore, weapon counts were determined for both types of battalions. In order to determine the feasibility of a MACS simulator/trainer for the various weapons (the fourth criterion), a structured interview was developed and administered to subject matter experts (SMEs) after they had been given a demonstration of MACS. A copy of the structured interview can be found in Appendix A and the credentials of the SMEs are presented in Appendix B. One purpose of the structured interview was to collect information about training components for each of the weapons. For example, the interview asked the SMEs to rate, on a scale of 1 to 9, both the difficulty and the importance of training different components (e.g., steady position, proper sight picture, breath control, moving targets, the effects of wind and gravity, etc.). This information provided guidelines for deciding which training components should be included on a MACS-type simulator/trainer (i.e., the training components that are rated high in importance and difficult to teach would be prime candidates for simulation).

In addition to providing information about which components to include, SMEs also were asked to rate the importance of various simulator qualities (e.g., the importance of realistic sound, targets, recoil, etc.). Besides being valuable input for the eventual simulation, these data also indirectly provide information about which weapons are likely candidates for MACS. This is because MACS simulates some components fairly well (e.g., realistic targets and terrain), but others poorly or not at all (e.g., the effects of recoil). Because there is no recoil on the current MACS configuration, if recoil were rated high in importance for a given weapon, then that weapon would have to be rated as low in feasibility relative to other weapons for which recoil was not judged to be important.

The interview also asked questions about current OSUT training (e.g., what are the firing positions, are targets moving or stationary, is firing single shot or automatic, and how many rounds do soldiers actually fire). Ratings also were obtained on the feasibility of obtaining dummy weapons for the MACS systems. Finally, each SME was asked his opinion about whether a simulator would fit into current training, and if it would be used as a free-time device.

It was also of interest to determine whether any MACS-type devices already exist. Both the technical literature and the SMEs were surveyed to obtain this information. A list of the literature reviewed is provided in Appendix C. This literature review included popular as well as technical journals, a DTIC computer search, and a review of ARI publications.

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RESULTS AND DISCUSSION

Currently Available Simulators

The search for information on currently available simulators revealed several very expensive simulators, but none in the price range of MACS ($2,000-$4,000). For example, the stationary target Weaponeer produced by Spartanics for the M16 rifle costs around $35,000 (Gingrich, 1981), and the moving target version is estimated around $50,000. The Unit Conduct of Fire Trainer (UCOFT) for unit gunnery training for the Bradley Infantry Fighting Vehicle (BIFV) is estimated to cost between $1.3 to $1.5 million. However, no low-cost simulators were identified. The Combat Classroom simulator by Sanders & Associates is similar to MACS in principle, but not in cost. This system can be configured to present training scenarios in multiple target engagement and weapon use such as shoulder-fired anti-armor weapons and BIFV weapons. However, the cost of this system is between $50,000 and $100,000 depending upon the configuration. It should be mentioned that the level of simulation and realism for the commercially available simulator/trainers is definitely superior to MACS. MACS is not intended to compete directly with those systems. Rather, if the Army is to have wide distribution of part-task simulators, a less expensive system like MACS is needed.

Stage 1: Representative U.S. Army Weapons

The results of the decision process depicted in Figure 1 are ⅎ ⅎ Table 2 and a list of weapons surviving the sort is shown in Table 3. following examples illustrate the steps involved in this sort for a weapon ⅎ was retained (i.e., the M16 rifle), and two weapons which were eliminatⅎ ⅎ further consideration (i.e., the Close Assault Weapon and the M21 Snⅎⅎ Rifle). The M16 survived the sort because it is not a new or replacement weapon; it is in the Army inventory; it is in the Infantry TO&E; it is not being phased out; and it is in the Mechanized Infantry TO&E. The Close Assault Weapon (CAW) was not retained for further investigation because no prototype is available. The M21 Sniper Rifle is another example of a weapon that did not survive the sort. This weapon successfully passed all criteria except the last; it is not in the Mechanized Infantry TO&E and, therefore, did not meet the operational definition used for representative U.S. Army weapons.

Stage 2: Rank Ordering the Representative U.S. Army Weapons

Given the list of potential candidates from Stage 1, the next step was to rank order the weapons in terms of their suitability for a MACS-type trainer/simulator. The four criteria used were: (1) the number of training hours currently devoted to that weapon in OSUT, (2) the current cost of ammunition, (3) current density in the Mechanized Infantry TO&E, and (4) the feasibility of creating a MACS application that would make a significant contribution to training.

The current density figures for the various weapon systems are shown in Table 2. The figures represent the weapon densities in the Mechanized Infantry TO&E at the battalion level. The multiplier for the brigade level is three, and to determine approximate numbers at the division level, the multiplier is nine. Current ammunition costs and number of hours devoted to each weapon in OSUT are shown in Table 4 along with other information about current OSUT training.

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Table 2

Results of Sort Routine

SMALL ARMS	NEW/ REPL Y/N	PROTO- TYPE Y/N	ADOPTED Y/N	INVENTORY Y/N	IN ANY INF TO&E Y/N	PHASED OUT Y/N	IN MECH INF Y/N	DENSITY W/BIFV	W/O BIFV
M16A1/M16A2 Rifle	N	-	-	Y	Y	N	Y	705	669
CAWS	Y	N	-	-	-	-	-	-	-
M14 Rifle	N	-	-	Y	N	-	-	-	-
M21 Sniper Rifle	N	-	-	Y	Y	N	N	-	-
M3A1 Submachinegun	N	-	-	Y	Y	Y	Y	32	32
M1911A1 .45 Cal Pistol	N	-	-	Y	Y	Y[1]	Y	108	180
XM177E2 Carbine	N	-	-	Y	N	-	-	-	-
MACHINEGUNS									
M60 Machinegun	N	-	-	Y	Y	N	Y	121	95
M249 SAW	Y	Y	Y	Y	Y	N	Y	54	54
M2HB .50 Cal Machinegun	N	-	-	Y	Y	N	Y	59	102
MK19 (Grenade) Machinegun	Y	Y	Y	Y	N[2]	N	N	-	-
Dover Devil	Y	Y	N	-	-	-	-	-	-
LAUNCHERS									
M203 Grenade Launcher	N	-	-	Y	Y	N	Y	95	87
M79 Grenade Launcher	N	-	-	N[3]	-	-	-	-	-
M202A1 FLASH	N	-	-	Y	Y	N	Y	18	18
ANTITANK									
TOW	N	-	-	Y	Y	N	Y	18	12
TOW 2	Y	Y	N	-	-	-	-	-	-
M40A2 106mm RR	N	-	-	Y	N[4]	Y[5]	N	-	-
M47 Dragon	N	-	-	Y	Y	N[6]	Y	67	4
Rattler	Y[7]	N	-	-	-	-	-	-	-
TAM	Y	N	-	N	-	-	-	-	-
M67 90mm RR	N	-	-	Y	Y	Y[8]	Y	0	18
M72A2 LAW	Issued as ammo							90	90[9]
Viper	Y	Y	N	-	-	-	-	-	-

Table 2
continued

MORTARS	NEW/REPL. Y/N	PROTO-TYPE Y/N	ADOPTED Y/N	INVENTORY Y/N	IN ANY INF TO&E Y/N	PHASED OUT Y/N	IN MECH INF Y/N	DENSITY W/BIFV	DENSITY W/O BIFV
M224 60mm Mortar	Y^{10}	–	–	Y	N	–	–	–	–
M29A1 81mm Mortar	N	–	–	Y	Y	Y^{11}	Y	9	9
XM252 81mm Mortar	Y^{12}	Y	N	N	–	–	–	–	–
M30 4.2-inch Mortar	N	–	–	Y	Y	Y^{13}	Y	4	4
MOUT WEAPONS									
RAW	Y^{14}	N	–	–	–	–	–	–	–
SHAWL	Y	N	–	–	–	–	–	–	–
BRADLEY INFANTRY FIGHTING VEHICLE									
M242 25mm	N	–	–	Y	Y	N	Y	45	0
M231 5.56mm Firing Port Weapon	N	–	–	Y	Y	N	Y	246	0

1   May be replaced by 9mm pistol

2   In Div 86

3   Replaced by M203/M16A1

4   National Guard & Reserves only

5   Being replaced by TOW

6   May be replaced by Rattler

7   Possible replacement for Dragon

8   Replaced by Dragon

9   Estimated allotment per battalion based on 4 per squad

10   Possible Replacement for M29

11   Will be replaced by M224 or XM252 in Mech. Inf.

12   Possible replacement for M30 & M29A1

13   May be replaced by XM252

14   Replacement for Viper/LAW

Table 3
Weapons Surviving the Sort

Small Arms

M16A1 5.56mm Rifle
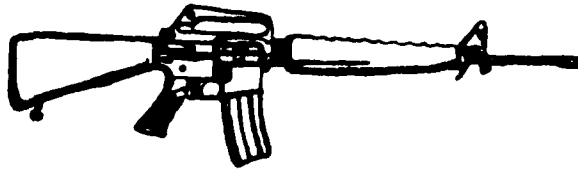
M1911A1 .45 Caliber Pistol
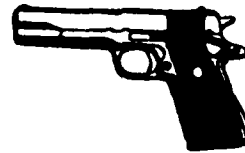
Machineguns

M249 5.56mm Squad Automatic
Weapon (SAW)

M60 7.62mm General Purpose
Machinegun

M2HB .50 Caliber Heavy
Machinegun

Launchers

M203 40mm Grenade Launcher

M202A1 66mm Incendiary Rocket
Launcher (FLASH)

Table 3
Continued

Antitank

TOW

Dragon

M72A2 LAW

Mortars

M29A1 81mm Mortar

M30 4.2 in. Heavy Mortar

Bradley Infantry Fighting
Vehicle

M242 25mm
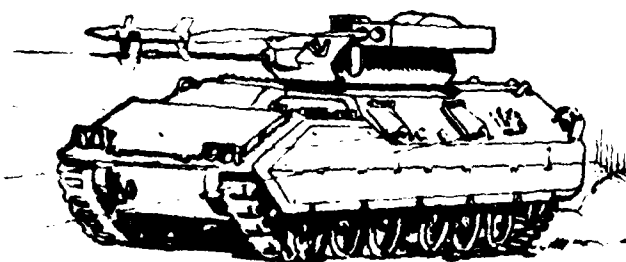
M231 5.56 Firing Port Weapon

Table 4

Current One Station Unit Training

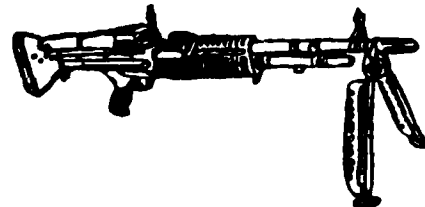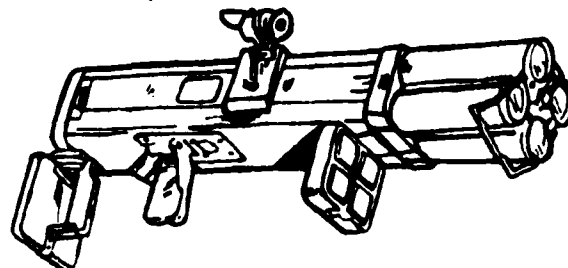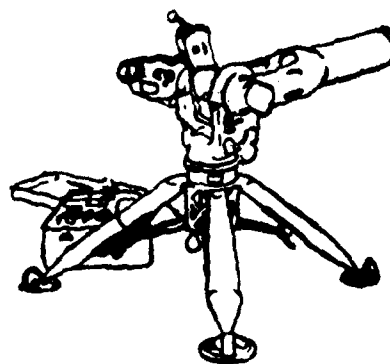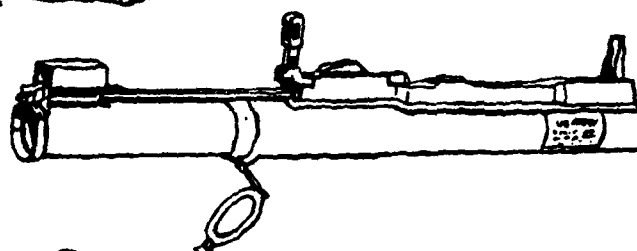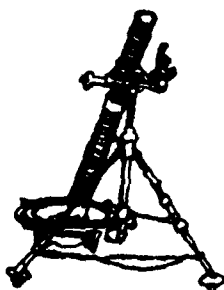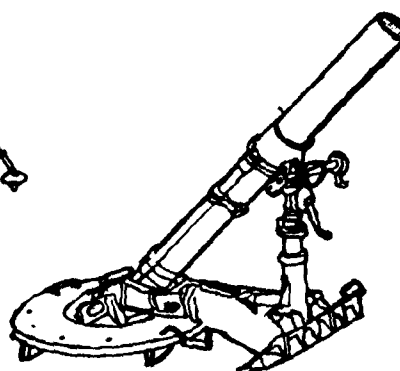|	1 Number of Hours	2 Firing Positions	3 Live Fire — Number of Rounds	Cost of Round	4 Moving Targets	5 Direct or Indirect Fire	Single Shot or Automatic	6 Rounds per Minute (if automatic)	Use of Tracers
SMALL ARMS:									
M16 Rifle	70	Prone unsupported; foxhole supported	386	$0.24	None in BRM (Some in ARM)	Direct	365 rnds (semi-auto); 21 rnds (automatic)	700-800 rpm cyclic rate	Occasionally
.45 Cal. Pistol	None	Two-handed standing	0	$0.21		Direct	Semi-Automatic	N/A	No
MACHINEGUNS:									
M60 Machinegun	28	Prone w/bipod and w/tripod	612	$0.37	None	Direct	Automatic w/6-9 rd. burst; ball on 10m range	550 rpm	4 balls to 1 tracer on transition range
M249 SAW	24 (Proposed)	Prone w/bipod (fox hole); assault fire	600-650 (Proposed)	$0.32	None	Direct	Automatic	700-1000 rpm	4 balls to 1 tracer on transition range
50 Cal. Machinegun	4	Tripod and vehicle mounted.	45	$0.35	None	Direct	Semi-automatic or fully auto.	450-550 rpm	Yes
LAUNCHERS:									
M203 Grenade Launcher	8	Prone supported, kneeling supported, foxhole	15 dummy rounds; 12 TP & 3 HE	TP $3.43 HE $10.98	None	Direct	Single shot	N/A	N/A
M202A1 Flash	None	Standing, kneeling, or prone	0	$494.00 per 4 round clip	None	Direct	Single or semi-automatic	1 round/ second	N/A
ANTITANK:									
M72A2 LAW	8	Standing supported; prone; prone supported	9 35mm subcal. rockets; 2 66mm HE M72A2 rockets/ class demo	TP $17.71 HE $150.00	Yes	Direct	Single	N/A	N/A
TOW	40	Ground tripod mount; vehicle mount	160 blast simulator rounds ($0.72 ea); 1 heat missile/ class demo	TP $5,500.00 HE $7,843.00	None	Direct	Single	N/A	N/A
M47 Dragon	40	Kneeling or standing supported; sitting	184 ctg, Grenade Rifle, 7.62mm, M64 (blast simulator, $0.34 ea); 1 HT/class demo	TP $3,817.00 HE $3,920.00	Yes	Direct	Single	N/A	N/A
MORTARS:									
M29A1 81mm Mortar	146	N/A	4	$122.00	None	Indirect	N/A	N/A	N/A
M30 4.2 in. Mortar	18	N/A	0	$79.90	None	Indirect	N/A	N/A	N/A

The fourth criterion (determining the feasibility and desirability of MACS for the various weapons) was the most difficult to derive because it involved both the subjective reports of the SMEs and the subjective analysis of those reports by the authors. Table 5 shows the results of the ratings obtained from the SMEs with regard to the nine training components and the five simulator qualities (median ratings are reported). In addition, the written comments of the SMEs can be found in Appendix D. In the following sections, brief discussions of the applicability of MACS training/simulation for each of the weapons are presented.

Small Arms

M16A1/A2 5.56mm Rifle. A prototype MACS has been developed for the M16 and already incorporates some of the training components that were rated as important: sight picture, the effects of wind, steady position, and moving targets (see Table 5). Trigger manipulation and breath control also were given high ratings and, therefore, should be included in the improved version of the M16 MACS. Realistic targets are important, especially in replicating relative size, and probably would contribute to training effectiveness. In the future, and with funds permitting, a videodisc could be used to present realistic and varied targets and terrain, in which case, target detection and identification could become two of the training objectives. The SMEs did not consider sound or recoil to be critical elements to simulate (Table 5). It was commented that sufficient exposure to realistic sound would be provided by live fire exercises. The SMEs generally felt that realistic recoil would contribute to training but that simulating recoil may not be cost-effective.

The consensus of the SMEs was that MACS would fit within current instruction time if enough units were available to prevent dead time while students waited to use the simulator. Use as a free-time device also was encouraged, even to the extent of charging 25 cents like other "games."

M1911A1 .45 Caliber Pistol. MACS probably can be adapted for .45 Caliber Pistol training. Fewer variables would need to be included in the scenario since several training components (e.g., range estimation, wind, and gravity), which were considered important for the M16, were rated as insignificant for the pistol. Moreover, the pistol is the second most numerous weapon in infantry units without BIFVs and third in units with BIFVs. However, training on this weapon is not included in OSUT and two of the three SMEs commented that a simulator for the pistol would not be cost effective for the Army. Also, the weight of the light pen and cord probably would distort the balance and "feel" of the pistol.

Machineguns

Strong consideration should be given to developing a MACS system for machineguns. These are high density weapons and are included in OSUT. The M60 is the most likely candidate at this time, because it is allocated the largest block of instruction. A training program for the Squad Automatic Weapon (SAW) is not yet in operation and the .50 Caliber Heavy Machinegun receives only 4 hours (see Table 4).

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Table 5

Median Ratings from Structured Interviews

	TRAINING COMPONENTS																				SIMULATOR QUALITIES					
	SIGHT PICTURE		STEADY POSITION		TRIGGER MANIPUL.		BREATH CONTROL		RANGE ESTIM.		EFFECTS OF WIND		EFFECTS OF GRAVITY		DIFFERENT TERRAIN		MOVING TARGETS		MISFIRE FREQ.		SOUND	RECOIL	MISFIRE	REALISTIC TARGETS	REALISTIC TERRAIN	N*
SMALL ARMS	IMP	DIF	IMP	DIF	IMP	DIF	IMP	DIF	IMP	DIF	IMP	DIF	IMP	DIF	IMP	DIF	IMP	DIF	IMP	DIF						
M16A1/M16A2 Rifle	9	6	8	6	8	7	7	6	6.5	7	7	8	5.5	7	4	5	8	9	5	5	3.5	6.5	4.5	8	5.5	12
M1911A1 Pistol	9	7.5	8.5	8	8.5	9	7	4	1.5	5	2.5	2	1.5	2	2	4	6	7.5	8	4.5	5	6	4.5	7.5	6	4
MACHINEGUNS																										
M60 Machinegun	9	5	5	4	6	6	6	3	8	8	7	8	7	7	5	5	8	8	6	5	4	8	3	8	6	5
M249 SAW	9	7.5	7	4.5	7.5	7.5	5	3	8.5	7.5	6	6	7	6	6	6	8.5	8.5	6	5	5.5	7	2.5	9	7	2
M2HB Machinegun	9	6	6	3	7.5	5	3.5	1.5	8.5	7.5	5	4	6	4	6	6	8.5	8.5	6	5	5	7	5	9	7	2
LAUNCHERS																										
M203 Grenade Launcher	6.5	5	5.5	4	4.5	4	4.5	4	8.5	8.5	7.5	7	6.5	4	6	6.5	8	8	6	3.5	3	4.5	4	6	5.5	5
M202A1 Flash	9	5	9	7	7	7	9	6	8	7	8	9	-	-	-	-	6	8	-	-	9	6	-	8	7	1
ANTITANK																										
M72A2 LAW	9	6	8	5	6	5	6	5	9	9	7	6	6	5	3	2	9	8	2	2	8	8	2	9	9	1
TOW	8	2.5	7	2.5	3.5	1.5	8	5.5	8	7.5	1.5	1.5	1.5	1.5	5	3.5	6.5	4.5	1.5	1.5	7.5	5	1.5	8.5	7	2
M47 Dragon	5	4	8	6	4	3	9	7	8	9	2	6	1	1	3	1	9	7	4	4	9	9	5	8	6	3

*Number of respondents.

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The most important training components included sight picture, trigger manipulation, range estimation, and moving targets (see Table 5). These components also were rated as difficult to train. The capabilities of a simulator to provide realistic recoil and realistic targets also were considered important (see Table 5). Although simulation of realistic recoil was considered to be very important, the present MACS configuration does not provide recoil and to include recoil would involve significant hardware changes.

M60 7.62mm General Purpose Machinegun. The M60 has an attached bipod mount and a separate tripod mount. The most accurate fire is achieved when firing from the prone position using the M122 tripod and the traversing and elevating mechanisms (FM 7-8). When the gunner is standing, the gun may be shot from the hip, underarm, or shoulder firing positions.

The most important training components and the ones most difficult to train were sight picture, trigger manipulation, range estimation, and moving targets. Training the correct sight picture was considered especially difficult at maximum range. Trigger manipulation is important in order to achieve the proper number of rounds in a burst (6-9), however, one SME considered burst control to be easier to teach than proper trigger squeeze with the rifle or pistol. Range estimation is critical because of trajectory and deviation from the line of sight at long ranges. The gunner must be able to estimate range in order to adjust his sights. Moving targets are a real-world threat, but current training includes only stationary targets.

A realistic recoil feature would be very desirable with any machinegun in order to show the soldier the effects of recoil on location of bullet strikes. However, in its present configuration, MACS does not have recoil capabilities. Realistic targets and terrain also would contribute to effective training, especially for range estimation. However, to do this well would involve the addition of a videodisc and thereby substantially increase the cost of the simulator.

Implementation prognosis was judged to be favorable for a M60 MACS. The SMEs predicted that the simulator/trainer would fit into current training and would be used as a free-time device. It also was commented that a simulator is needed to maintain gunner proficiency.

M249 5.56mm Squad Automatic Weapon. The Squad Automatic Weapon (SAW) is a new weapon designed to replace the M16 in the hands of the automatic rifleman. The SAW has a slightly shorter range than the M60, but fires more rounds per minute. However, a program of instruction is not yet available for the SAW.

M2HB .50 Caliber Heavy Machinegun. The .50 Caliber Machinegun is operated from a tripod mount so neither the steady position nor the breath control training components were considered to be important factors since stability is provided by the mount. Special simulation problems would accompany the vehicle mounted .50 Caliber Machinegun because it is fired by looking over the barrel and adjusting from the tracers and beaten zone. The simulation problem of adjusting fire from the tracers and beaten zone is not unique to the .50 Caliber Machinegun, but also would apply to the M60 and the SAW. As with the other machineguns, recoil was considered an important characteristic to simulate. Another limitation of a MACS trainer for the .50 Caliber Machinegun would be the amount of space needed to accommodate the weapon and mount. The size of the

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weapon may prohibit the simulator from being used as a free-time device if space in a Day Room and Secure Room were limited.

Launchers

M203 40mm Grenade Launcher. The M203 is a lightweight, single-shot, breech loaded, pump-action (sliding barrel), shoulder-fired weapon that attaches to the M16 rifle. The M203 consists of a handguard and sight assembly group, receiver assembly, quadrant sight assembly, and barrel assembly (FM 23-31).

The M203 is a viable candidate for a MACS-type simulator for several reasons: (1) training on this weapon is included in OSUT, (2) the cost of an additional weapon would be small because the pieces composing the M203 would fit onto the MACS M16 dummy weapon, and (3) simulating sound, recoil, and misfire were not considered critical. Range estimation, effects of wind, and moving targets were considered to be the most important and difficult factors. Wind effects are especially critical when lobbing grenades. The angle at which the weapon is held presents a potential problem in attaching the light pen. However, this does not appear to be an insurmountable drawback.

M202A1 66mm Incendiary Rocket Launcher (FLASH). The M202A1 is a lightweight, four-tube rocket launcher (FM 7-8). It is aimed and shot from the right shoulder in the standing, kneeling, or prone position with the most stable position being the standing supported (foxhole) position. It can shoot a single rocket or up to four rockets semi-automatically at a rate of one rocket per second. It is reloaded with a clip of four rockets.

The M202A1 is a direct-fire weapon and the sighting mechanism should accommodate a light pen with minimal difficulty. Also, a simulator would prove cost-effective since the rockets cost $494 per four-round clip. Also, the weapon has little recoil, so that would not be necessary to simulate. However, the FLASH will not receive a high priority because: (1) it has a low density, (2) it is not included in OSUT, and (3) target engagement with the M202A1 is less difficult than on the other weapons.

Antitank Weapons

The antitank weapons are excellent candidates for MACS. These are basic infantry weapons that are included in OSUT. Furthermore, the ammunition for these weapons is expensive (see Table 4), therefore, making a simulator cost-effective. One company (Sanders) advertises a video trainer for antitank weapons, but the cost is estimated between $50,000-$100,000.

M72A2 Light Antitank Weapon (LAW). The M72A2 is a self-contained unit consisting of a 66mm HEAT rocket in a disposable fiberglass and aluminum launcher tube. Its light weight and ability to penetrate more than 30 cm of armor make it effective against armor, bunkers, and other hard targets out to a range of 200 m (FM 7-8). Other versions of a light antitank weapon, besides the M72A2, currently are being designed and tested. The Viper is one such variant that has been determined to be unacceptable. Other variations of the ILAW (Improved Light Antitank Weapon) are still under consideration. The original MACS system developed by the Army Research Institute included an antitank scenario which used the Viper, but could be adapted for any version of a light antitank weapon similar to the M72A2.

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M476 Dragon Medium Antitank Missile. The Dragon is a wire-guided missile that is man-portable and shoulder-fired. It consists of two components: the tracker and the round. The round is composed of the launcher and the missile which are packaged together. The round is the expendable component, but the tracker is reuseable. To engage targets, the gunner looks through the sight in the tracker, puts the crosshairs on the target, and fires. The missile is continuously guided along the gunner's line of sight. The tracker detects deviations from the line of sight and sends corrections to the missile by a wire link (FM 7-8).

Antitank SMEs agreed that a simulator must replicate the character- istics of the missile leaving the tube: realistic sound, backblast, weight shift, and smoke obscurity. These characteristics would be difficult and expensive to simulate. Moreover, there is training equipment available that simulates the launch of a Dragon missile. The LET (Launch Effects Trainer) uses a M64 grenade cartridge to drive a dummy weight forward in the pressure tube to simulate weight loss and recoil (TC 23-24). When used in combination with the other Dragon training equipment (monitoring set, field handling trainer, and infrared transmitter), it is possible to determine hits and misses, at what points tracking was off, and the direction of the errors.

A new missile flight simulator for Dragon gunners called STAGS (Simulated Tank and Antiarmor Gunnery System) has been produced by the Advanced Concepts Laboratory of the Naval Training Equipment Center, and currently is undergoing testing. A version for the TOW also is being developed. The system uses a terrain board, with moving enemy armored vehicles which create a variety of attack scenarios. Missile firing is accompanied by simulated weight loss, recoil, the smoke of the missile launch, and simulated sound. When the smoke clears, the gunner can see the missile and target in the sight. The gunner's aiming error is measured using a microprocessor-controlled diode matrix. The matrix detector senses an infrared emitting diode located on the miniature target. The missile's flight equations are solved by a 16-bit microprocessor every .02 sec in each axis using gunner aiming error, target position, gravity, drag, and side thruster accelerations as inputs. A second coordinated microprocessor controls the display which plots vertical and horizontal aiming error for the evaluation of the gunner's performance. Experienced Dragon gunners have tested the STAGS system and were favorably impressed with its realism and teaching attributes (Marshall, Towle, Shaw, Bond, and Siragusa, 1981).

TOW Heavy Antitank Missile. The TOW system is a crew-portable and vehicle mounted heavy antitank weapon consisting of a launcher with tracking and control capabilities, and a tube-launched, optically-tracked, wire-command link (TOW) guided missile encased in a launch container (TC 23-23). The missile can be launched from a tripod ground mount or from a vehicle mount. The automatic missile tracking capabilities permit a high first hit probability. To operate the system, the gunner places the crosshairs of the optical sight on the target, fires the missile, and keeps the crosshairs centered on the target until missile impact. The optical tracking and command functions guide the missile along the gunner's line of sight. The gunner does not apply lead, windage, or elevation. The TOW has a crew-portable trainer (the XM70), consisting of an instructor console, missile simulation round, and a target set. Line-of-sight errors are

detected and graded in the instructor's console (TC 23-23, DA PAM 310-12). The cost of the trainer is approximately $16,000.

A video simulator could provide tracking experience and would be cost effective due to the expense of live rounds (see Table 4). Reproducing the experience of the missile being launched was considered important. The SME's commented that since recoil is minimal, it is not a critical feature to simulate. A MACS adapation for the TOW would be cumbersome as a free-time device, but it might have some value in regular training.

Mortars

Mortars present a unique problem in that they are indirect-fire weapons. A simulator would be more suited for the forward observer (FO) and/or for the fire direction center (FDC) than for the actual gunner. Forward observer training could focus on target detection by using a videodisc to present realistic terrain and targets. The FO would then call in the target information to the FDC who would make the necessary calculations and call for fire. In this manner either team training or individual training (with the computer providing the missing links) could be simulated. However, since this approach is different from the projected use of MACS (e.g., attaching the light pen to the weapon), mortars are not recommended for further consideration in a MACS-type training configuration. Additionally, mortars are not included in Table 5, since the training components and simulator qualities did not apply to mortars. However, comments from SMEs are included in Appendix D.

An artillery simulator produced by Invertron Simulated Systems Ltd. at a cost of $86,000 is available for FO training. The system uses a DEC PDP11/23 processor, VT 100 CRT, RX02 floppy disk, tape cassette for audio, and 11 carrousel slide projectors for video. The system is estimated to pay for itself in four years.

Bradley Infantry Fighting Vehicle

Recommendations for the M242 25mm and the M231 5.56mm weapons on the Bradley Infantry Fighting Vehicle will be postponed until a training program is established for this system.

Rank Ordering the Final List

The ultimate goal of the present effort was the formation of a list of representative U.S. Army weapons rank ordered in terms of their suitability for a MACS-type trainer/simulator. In Stage 1, the entire list of weapons was narrowed to 10 candidate representative weapons. Selection in Stage 1 was based on whether a given weapon satisfied a number of criteria. In Stage 2, another set of criteria was established in order to form the final list: (1) the number of hours of OSUT devoted to the weapon, (2) the cost of the weapon, (3) the density of the weapon, and (4) the feasibility/ desirability of MACS application for each weapon. Criteria 1-3 information can be found in Tables 2, 4, and 5. The determination of values for criterion 4 was more difficult because it was based on the subjective estimates of the trainers and the MACS developers. The weapons were rank ordered on the basis of the reactions of the training experts and on a feasibility estimate of adapting MACS hardware and software for a given weapon.

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In the final analysis shown in Table 6, the rows represent the different candidate weapons from Stage 1. The first four columns represent the final rank orders for the four criteria. Rank orders were used because they represent a simple relative index and because it was decided that all four criteria should receive the same weight in the final determination. For example, in column 1 (Hours of OSUT), the M16 was given the rank of 1 because it has more hours of OSUT devoted to it than any of the other weapons. The Dragon and the TOW were tied for second and so both were given the rank of 2.5, etc. The weapons were then ranked on feasibility. The weapons ranked 1 through 5 on MACS Feasibility (column 4) were considered highly compatible with a MACS-type trainer. The machineguns, which received ratings 6 through 8, were considered less compatible with MACS because of the technical difficulty and cost involved with simulating recoil and automatic fire. Finally, the two larger antitank weapons, the Dragon and the TOW received the lowest priority consideration for MACS. These low ratings were based on (1) the technical difficulty and cost involved with simulating the characteristics of the missile leaving the tube, and (2) the fact that training equipment that simulates the missile launch (the LET) currently is available.

The fifth column is simply the sum of the ranks for a particular weapon. The sixth column is the rank order of the sums from column 5, and represents the main end product of this effort. As can be seen in Table 6, the M16 was given the highest priority followed by the M72A2 LAW, M203, M60, Dragon, TOW, .45 Caliber Pistol, SAW, FLASH, and the .50 Caliber Machinegun.

This decision process is admittedly crude. However, it is only intended to provide guidelines about which weapons should be considered first. It does not preclude MACS from being adapted to any of the weapons listed, nor does it insure that MACS will be adapted to any of the weapons. It is merely a list of weapons in the order in which they should be considered for MACS application.

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Table 6

Determination of Final List

Weapon	Hours OSUT	Ammunition Cost/Round	Density	MACS Feasibility	Sum	Priority
M16	1	9	1	1	12	1
.45 Cal. Pistol	9.5	10	2	4	25.5	7
M60 MG	4	7	3	6	20.0	4
SAW	5	8	7	7	27.0	8
.50 Cal MG	8	6	6	8	28	10
M203	6.5	5	4	3	18.5	3
M202A1	9.5	4	9	5	27.5	9
M72A2 LAW	6.5	3	5	2	16.5	2
Dragon	2.5	2	8	9	21.5	5
TOW	2.5	1	10	10	23.5	6

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Department of the Army. TOW heavy antitank weapon system. TC 23-23, July 1970.

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APPENDIX A
STRUCTURED INTERVIEW

1. TRAINING COMPONENTS

   Rate the following training components in response to:

   (1) How <u>important</u> would it be to simulate training that component?

1	2	3	4	5	6	7	8	9
not								very
important								important

   (2) How <u>difficult</u> is it <u>to train</u> that component?

1	2	3	4	5	6	7	8	9
very								very
easy								difficult

   Please supplement ratings with comments.

COMPONENT	RATING		COMMENTS
1. Correct Sight Picture:	Imp.	Dif.	
Importance			
Difficult to Train			
2. Steady Position:	Imp.	Dif.	
Importance			
Difficult to Train			
3. Trigger Manipulation:	Imp.	Dif.	
Importance			
Difficult to Train			
4. Breath Control:	Imp.	Dif.	
Importance			
Difficult to Train			
5. Range Estimation:	Imp.	Dif.	
Importance			
Difficult to Train			
6. Effects of Wind:	Imp.	Dif.	
Importance			
Difficult to Train			
7. Effects of Gravity:	Imp.	Dif.	
Importance			
Difficult to Train			
8. Different Terrain:	Imp.	Dif.	
Importance			
Difficult to Train			
9. Moving Targets:	Imp.	Dif.	
Importance			
Difficult to Train			
10. Misfire Frequency:	Imp.	Dif.	
Importance			
Difficult to Train			
11. Other	Imp.	Dif.	

II. CURRENT TRAINING

Respond to the following items in terms of current training.

1. Number of Hours

2. Firing Positions

3. Live Fire

   a. Number of Rounds

   b. Cost of Round

4. Moving Targets

5. Direct or Indirect Fire

6. Single Shot or Automatic

   a. Rounds Per Minute
      (if automatic)

   b. Use of Tracers

III. SIMULATORS

The following items pertain to existing simulators for the weapon.

1. Name, manufacturer,
   address, etc.

2. Purchase Cost

3. Maintenance Cost

4. Strengths

5. Weaknesses

6. Scientific Evaluations
   Conducted

7. Acceptance by Trainers

III. SIMULATORS (Continued)

    8. Training Aids Available

        a. Training Purpose

        b. Name, source, etc.

        c. Cost

IV. IMPORTANT QUALITIES OF A SIMULATOR

    Please rate the importance of simulating the following qualities.

1	2	3	4	5	6	7	8	9
not important								very important

    Please include comments.

QUALITY	RATING	COMMENTS
1. Realistic Sound		
2. Realistic Recoil		
3. Misfire Capabilities		
4. Realistic Targets		
5. Realistic Terrain		

V. FEASIBILITY

    1. How difficult would it be to obtain a dummy weapon? (Circle one number)

1	2	3	4	5	6	7	8	9
very easy								very difficult

    Comments:

    2. Estimate the cost of a dummy weapon.

V. FEASIBILITY (Continued)

    3. Hardware Feasibility

    4. Hardware Cost

    5. Software Feasibility

    6. Software Cost

VI. IMPLEMENTATION

In your opinion:

1. Would a simulator fit into current instruction?

2. Would a simulator be used as a "free time" device?

APPENDIX B

QUALIFICATIONS OF SUBJECT MATTER EXPERTS

Respondent Number	M16A1/A2 5.56mm Rifle

1   Army Research Institute; 10+ years experience in small arms systems marksmanship training

2   Army Research Institute/Litton Mellonics; 30 years shooting background; 20 years U.S. Army Ordnance; Retired LTC; OIC both U.S. Army Pistol and Running Target Teams

3   Army Research Institute; Research and training development; 3 years on rifle marksmanship

4   Army Research Institute/Litton Mellonics; Military service, 26 years; SGM Weapons Department 2 years; SGM of Director of Training 2 1/2 years; Commandant NCOA 2 years

5   Army Research Institute/Litton Mellonics; 2 years research M16 rifle marksmanship training

6   Basic Rifle Marksmanship Committee, Infantry Training Group; 5 years military service

7   Basic Rifle Marksmanship Committee, Weapons Officer, Infantry Training Group

8   Service Rifle Branch, Army Marksmanship Unit

9   Weapons Branch, Systems Division, Directorate of Training Development; Infantry 13 years

10   Army Research Institute; Trained to use and qualify annually 13 years; Includes training program component development

11   Small Arms Test Division, Army Infantry Board; Infantry 16 years; Taught rifle marksmanship instruction; Performed tests for USAIB using M16A1 rifle; 3 years small arms test officer

12   National Guard Unit Marksmanship Center

M19111A1 .45 Caliber Pistol

13   Army Research Insitute/Litton Mellonics; 30 years shooting background; 20 years U.S. Army Ordnance; Retired LTC; OIC both U.S. Army Pistol and Running Target Teams

14   Army Research Institute; Trained to use and qualify annually 4 years; Training program research and development

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Respondent
Number   <u>M19111A1 .45 Caliber Pistol</u> Continued

15   Pistol Branch, Army Marksmanship Unit; Infantry 28 years

16   Small Arms Test Division, Army Infantry Board; Military service
          16+ years; Fired M1911A1 pistol in competition, 18 years; Taught
          rifle and pistol marksmanship

          <u>Machineguns</u>

17   Army Research Institute/Litton Mellonics; 30 years shooting
          background; 20 years U.S. Army Ordnance; Retired LTC

18   Army Research Institute; Research in program development 3 years;
          Georgia Army National Guard unit training officers for refresher
          training, 2 years; Expert qualification

19   Weapons Branch, Systems Division, Directorate of Training Develop-
          ment; Infantry 13 years

20   Basic Rifle Marksmanship, Infantry Training Group; 5 years military
          service

21   Small Arms Test Division, Army Infantry Board; Fired machineguns
          19 years; Experience in Vietnam; In Europe, trained the 3rd
          Armored Division machinegun team

          <u>Launchers</u>

22   Weapons Branch, Systems Division, Directorate of Training Develop-
          ment

23   Army Research Institute/Litton Mellonics; Infantry 11B/11C/11H, 22
          years

24   Army Research Institute; Research and training development 3 years

25   M203 Committee, Infantry Training Group

26   Army Research Institute; Qualification firing, 2 years

27   Army Research Institute/Litton Mellonics; Military service, 26
          years; SGM Weapons Department 2 years; SGM of Director of Training
          2 1/2 years; Commandant NCOA 2 years

          <u>Antitank</u>

28   Army Research Institute; Research and development; Training
          program monitoring; Qualification

APPENDIX B Continued

Respondent Number	Antitank Continued

29   Army Research Institute/Litton Mellonics; Military service, 26 years; SGM Weapons Department 2 years; SGM of Director of Training 2 1/2 years; Commandant NCOA 2 years

30   Weapons Branch, Systems Division, Directorate of Training Development

31   Army Research Institute; Research on selection characteristics for Dragon gunners; Evaluation of LET

Mortars

32   Army Research Institute/Litton Mellonics; Infantry 11B/11C/11H, 22 years; Research on training programs

33   Army Research Institute/Litton Mellonics; Military service, 20 years (Infantry Officer; Major-retired); Research on training programs

34   Manuals and Test Branch, Training Support Division, Directorate of Training Development; Military service, 20 years

35   Manuals and Test Branch, Training Support Division, Directorate of Training Development; Military Service, 15 years; Directorate of Training Development, 2 years

36   Army Research Institute; Mortar Platoon leader; Research and development and training effectiveness analysis

APPENDIX C
LITERATURE SEARCH FOR INFORMATION
ON LOW-COST VIDEO SIMULATORS

1. Readers Guide to Periodical Literature

   Business Week
   Forbes
   Fortune
   Scientific America
   Scientific Digest
   Time

2. Air University Library to Military Periodicals

   Air Force Magazine
   Armada International
   Army
   Army Communicator (Voice of the Signal Corps)
   Armor
   Asian Defense Journal
   Aviation Week in Space and Technology
   Defense Electronics
   Defense Management Journal
   International Defense Review
   Military Electronics Countermeasures
   National Defense
   NATO's Fifteen Nations
   Signal
   Soldiers

3. Other Periodicals (independent search)

   Armed Forces Journal International
   Army Reserve
   Instructional Innovation
   New Technology Showcase
   Popular Science
   Research, Development and Acquisition
   Scientific American

4. Books,Manuals, and Technical Reports

   Army Research Institute - Ft. Benning Field Unit Library
     (Tech. Reports)
   Index and description of Army Training Devices
   The Electronic Battlefield
   Training Manuals 9-6920-427-10
                    9-1265-370-10-2
                    9-1265-368-10-3

5. Computer Search Request of Wm. J. Donovan Technical
   Library using the following key words or phrases:

arcade	video	war games
technical devices	videodisc	

APPENDIX D

SUBJECT MATTER EXPERTS' WRITTEN COMMENTS ON STRUCTURED INTERVIEW

M16A1/A2 5.56mm Rifle

I. TRAINING COMPONENTS (Respondent No.; Importance/Difficulty Rating)

1. <u>Correct Sight Picture</u>:

Static is easy—moving, etc. is not easy. (1; 9/1)

Not difficult to train provided adequate time and proper training
is employed. (2; 9/5)

Without correct sight picture, you will not hit target. Very
few people take the same sight picture. (4; 9/9)

No method for determining firer's actual sight picture during
live fire conditions. (5; 9/9)

This is the most difficult fundamental for a trainer to observe
and correct. (6; 9/9)

#1-4 are the fundamentals, therefore, I feel that they are
more important than #5-10. (7; 8/7)

All (#1-4) are very important. All must tie together. #1 is
not difficult to train if properly explained and taught in the first
place. (8; 9/4)

Very important task whether basic training or advanced rifle
marksmanship. (9; 9/9)

An approximately correct sight picture is important, perfect
is not. (11; 7/5)

2. <u>Steady Position</u>:

Easier to describe than to do. (1; 9/5)

Not difficult to train provided adequate time and proper training
is employed. (2; 9/5)

I. TRAINING COMPONENTS (cont'd)

2. Steady Position: (cont'd)

Ties in with #1 above--must have a good steady position. It is very difficult to teach unsupported position. (4; 7/9)

This takes the most practice. (8; 9/8)

Without steady position, correct sight picture cannot be obtained. (9; 8/5)

3. Trigger Manipulation:

Hard to get enough practice under conditions that really "cause" flinch (e.g., live fire). (1; 9/7)

Not difficult to train provided adequate time and proper training is employed. Training must include lots of "snapping in" exercises. (2; 9/5)

Must be taught to squeeze rather than jerk trigger. Can be taught through repetition drills. (4; 7/5)

This is easily trained using the dime/washer exercise. (6; 7/5)

Comes only after much experience. (8; 9/8)

Another integral part of the act of shooting. (9; 6/4)

4. Breath Control:

Breath control relates to steady position, people probably don't get enough practice. (1; 7/5)

Must be learned through experience/OJT. (4; 8/8)

Comes only after much experience. (8; 9/7)

Without breath control--sloppy shot group. Very little training is accomplished with this in mind. (9; 7/7)

J.   TRAINING COMPONENTS (cont'd)

5. Range Estimation:

Important beyond 300 meters. Probably never taught well enough
to help much. (1; 5/9)

Over the ranges the rifle is employed (0-300m), range estimation
is not difficult. (2; 5/5)

Same as #4--must be learned through experience/OJT. (4; 7/5)

Range estimation and different terrain are closely related.
Range estimation is difficult to teach. (8; 8/8)

A better job needs to be done in training range estimation for
all weapons systems. (9; 8/9)

Not important from 0-300 meters. (11; 5/8)

6. Effects of Wind:

The difficulty here is that wind interacts with range estimation.
If you know wind speed but not range, your holdoff could be wrong.
(1; 7/7)

Since most targets are large and at short ranges this is not as
critical as fundamental training. (2; 7/9)

Wind has a great impact on bullet trajectory. Would be great if
this could be simulated. On the range, this is hard to determine--
one day the wind will be blowing hard--the next day not at all.
(4; 8/9)

This is extremely difficult to get across to a soldier on a
range, because he cannot see it. (6; 8/8)

This takes much experience to master. (8; 9/8)

D-3

I. TRAINING COMPONENTS (cont'd)

6. <u>Effects of Wind</u>: (cont'd)

Not important for basic training fundamentals, only required in competition. However, it should be understood. (9; 5/7)

A shooter should have a good idea about effects of wind but the presentation should be kept basic and easy to understand. (11; 7/9)

7. <u>Effects of Gravity</u>:

Again, this variable interacts with range. Not too important until in excess of 300 meters. (1; 5/7)

The difference in the trajectory over the short ranges, 50-300m, is not great or serious. (2; 5/5)

Experience is most important. (8; 8/8)

Same as #6--not important for basic training fundamentals, only required in competition. However, the effect of gravity should be understood. (9; 5/4)

Effects of gravity and trajectory reference line-of-sight are important in general terms (BASICS). (11; 3/7)

8. <u>Different Terrain</u>:

Don't know relevance to M16A1 here. (1; 3/3)

Terrain--targets--light--must permit a sight picture to be attained. (2; 9/7)

Would be less than #6. (9; 3/2)

9. <u>Moving Targets</u>:

Most targets in combat are moving but are less likely to hit you while moving. (1; 6/9)

I.   TRAINING COMPONENTS (cont'd)

    9.   <u>Moving Targets</u>:   (cont'd)

          In the real-world, most targets will be moving. (2; 9/9)

          Moving targets are much harder to hit than stationary especially

at greater distances.   There are mechanical problems with moving

targets on the ranges.   Plus, teaching soldiers proper techniques in

leading the target is difficult. (4; 8/9)

          This is an advanced technique that we do not spend enough time

on. (6; 8/8)

          Should come only after other phases are mastered. (8; 5/9)

          I personally feel this skill is important--many experts disagree.

(9; 8/9)

    10.   <u>Misfire Frequency</u>:

          There are few good opportunities to train this well (in live

fire). (1; 6/6)

          How to handle misfire can be achieved on the real weapon.

(2; 4/4)

          Correcting a misfire is not hard to understand. (9; 5/1)

    11.   <u>Other</u>:

          Target detection--can't hit what you don't find.   Tough to train

people to do it. (1; 7/7)

          Twilight/night fire--perhaps can be trained better on a simulator

than in the real-world. (2; 9/9)

          Magazine change in combat conditions--may have an impact when

given a moving target scenario. (9; 5/6)

IV. IMPORTANT QUALITIES OF A SIMULATOR (Respondent No.; Rating)

1. Realistic Sound:

If these (#1 & #2) simulated the fear and/or startle it might be important to simulate them, but I suspect it wouldn't be so. (1; 1)

Important (#1 & #2) for training in order to add realism, and to maintain interest. (2; 6)

The soldier must be familiar with how weapon sounds on firing. (4; 9)

Sound is nice to have but not necessary. (6; 4)

May or may not be important--I feel that dry fire may be as effective. (9; 3)

Can be handled with live fire exposure. (10; 3)

Contributes little or detracts little from rifle training. (11; 1)

2. Realistic Recoil:

If these (#1 & #2) simulated the fear and/or startle of combat it might be important to simulate them, but I suspect it wouldn't be so. (1; 3)

Important (#1 & #2) for training, realism, and to maintain interest. (2; 6)

Realistic recoil is needed because it could cause strike of bullet to move considerably. (4; 9)

Recoil is nice to have but not necessary. (6; 4)

Recoil is important, but if it makes the cost of the system too expensive, then I would go without it. (7; 7)

This may or may not be needed in a laser device. (9; 5)

IV.   IMPORTANT QUALITIES OF A SIMULATOR (cont'd)

2.   Realistic Recoil: (cont'd)

In multiple enagements, it throws fire off target. (10; 8)

It would prevent simulator from being like a toy if realistic recoil were incorporated. (11; 7)

3.   Misfire Capabilities:

This could be simulated and would be good training. (1; 7)

This can be learned on a real rifle. (2; 1)

Recognizing a misfire & knowing how to handle one can be taught during mechanical training. (4; 5)

This is important in order to detect trigger jerk. (6; 8)

This can be accomplished by other means. (9; 2)

This is expensive when compared to benefits beyond drill. (10; 4)

Misfire procedures need to be taught and practiced somewhere, sometime, but maybe not with a simulator. (11; 5)

4.   Realistic Targets:

They don't need to look real if they convey the information needed. (1; 3)

Realistic targets would be best. (2; 9)

Targets must simulate actual targets. (4; 9)

In order to comprehend the correct aiming point, the soldier must be presented with realistic target arrays. (6; 9)

Realistic targets are very important. (9; 9)

Size yes, motion yes, "realistic" no. (10; 2)

Targets similar to standard U.S. Army E & F silhouettes are adequate. (11; 7)

IV. IMPORTANT QUALITIES OF A SIMULATOR (cont'd)

5. Realistic Terrain:

Engaging targets in likely geographic areas could be of value.
Then some realism might be important. (1; 3)

Videodisc of realistic terrain would be the best. (2; 9)

Simulator should try to depict all types of terrain from slightly
vegetated to jungle to desert. (4; 7)

May or may not affect training transfer for actual weapon. (9; 6)

Use a slide projector if variety is desired. (10; 2)

This would be helpful because it would add realism. (11; 6)

VI. IMPLEMENTATION (Respondent No.)

1. Would a simulator fit into current instruction?

Yes. (1)

Yes, more so in units, but also possible in institutions. (3)

Yes, especially OSUT and possible TO&E units. (4)

Yes. (5)

Yes, if it was used for additional training in a company area.
Unless provided in large numbers, it would not be feasible for use on
a range. (6)

Yes--would be good for either a main period of instruction or
as concurrent training. (7)

Absolutely. (8)

Yes. Currently, there are many members in the Army who do not
have the capability to use the actual weapon--SM serving in Recruiting
Command assignments--Reserve Component ⌐ NG would have an ability

D-8

VI. IMPLEMENTATION (cont'd)

1. Would a simulator fit into current instruction? (cont'd)

to qualify annually given a device such as this. A generic trainer

(video) could accomplish a wide range of weapons and provide a

training vehicle indoors where most units don't have that capability. (9)

Yes. (10)

Definitely. (11)

2. Would a simulator be used as a "free time" device?

Yes. (1)

Yes, more so in units, but also possible in institutions. Dry

fire is excellent. (3)

I think so. (4)

Perhaps. (5)

It should be promoted as such. (6)

Yes--it would be perfect in a day room or used as concurrent

training on a range. (7)

Absolutely. (8)

No. (9)

If some form of competition were to be encouraged. (10)

Hopefully, this should be encouraged. The Canadian Army is

considering purchasing WEAPONEERs and placing them in day rooms and

charging 25¢ like a slot machine. (11)

M1911A1 .45 Caliber Pistol

I. TRAINING COMPONENTS (Respondent No.; Importance/Difficulty Rating)

1. Correct Sight Picture:

    Sight picture is required at ranges beyond 10m. (13; 9/7)

    Sight picture/sight alignment is even more important than

    with rifle. (16; 9/8)

2. Steady Position:

    This is even more important than with the rifle except at

    close range. At ranges 15 meters or less, pointing is acceptable.

    (16; 9/8)

3. Trigger Manipulation:

    Trigger control is the most important and difficult pistol

    fundamental to master. Video display for detecting errors would be

    most helpful. (15; 9/9)

4. Breath Control:

    No comments.

5. Range Estimation:

    Disregard at pistol ranges. (16; 1/8)

6. Effects of Wind:

    This is not very important for pistol, as normal engagement

    range is 25 yds. But the ability to know and apply "Kentucky

    Windage" is important. (15; 2/2)

    Disregard at pistol ranges. (16; 1/8)

7. Effects of Gravity:

    This is not very important for pistol, as normal engagement

    range is 25 yards. (15; 2/2)

    Disregard at pistol ranges. (16; 1/8)

1. TRAINING COMPONENTS (cont'd)

8. <u>Different Terrain</u>:

This would be helpful for night firing, or other limited visi-

bility firing situations. (13; 9/9)

9. <u>Moving Targets</u>:

No comments.

10. <u>Misfire Frequency</u>:

This could be of great importance for a personal defense

weapon. (16; 9/5)

11. <u>Other</u>:

Point shooting - short exposure targets at 10m and less. (13; no

rating)

Proper grip of the pistol. (15; 7/5)

IV. IMPORTANT QUALITIES OF A SIMULATOR (Respondent No.; Rating)

1. <u>Realistic Sound</u>:

This contributes little or detracts little from pistol training.

(16; 1)

2. <u>Realistic Recoil</u>:

It would prevent simulator from being like a toy if realistic

recoil were to be incorporated. (16; 7)

3. <u>Misfire Capabilities</u>:

If this were trained on real pistols, then it would not be an

important factor for simulation. (13; 3)

This need not be taught with a simulator, but should be taught

somewhere. (16; 5)

IV. IMPORTANT QUALITIES OF A SIMULATOR (Respondent No.; Rating)

4. <u>Realistic Targets</u>:

Standard silhouette targets are adequate. (16; 5)

5. <u>Realistic Terrain</u>:

Should include limited visibility targets. (13; 9)

Good because it adds realism. (16; 6)

VI. IMPLEMENTATION (Respondent No.)

1. <u>Would a simulator fit into current instructions?</u>

Yes. (15)

Definitely. (16)

2. <u>Would a simulator be used as a "free time" device?</u>

The Army wouldn't find it cost effective to simulate pistol
training. (14)

Yes. (15)

Hopefully, but this will only be used by the soldier if it
is somewhat realistic, presents a challenge (can be used in com-
petition with his buddies or to beat his previous score). Scenarios
should be available that produce increasing degrees of difficulty.
(16)

M60 7.62mm General Purpose Machinegun

1. TRAINING COMPONENTS (Respondent No.; Importance/Difficulty Rating)

1. Correct Sight Picture:

This could be a problem out to maximum range of the weapons (1,100 on maximum effectiveness). (19; 5/4)

As with the M16, this is most important. (20; 9/9)

2. Steady Position:

This is important, but is based on degree and physical setting - bipod vs. tripod. (19; 5/4)

Much of the steady position is contributed by the bipod or tripod, but a proper position is still important to properly control gun and beaten zone. (21; 5/5)

3. Trigger Manipulation:

There is much discussion on 3 to 5, 6 to 9, or 10 to 15 round burst for which system. This is still in debate. (19; 6/8)

The importance factor here is to obtain a 6 to 9 round burst. (20; 6/6)

Trigger manipulation is important in order to achieve the proper number of rounds in a burst, but it is easier to teach than proper squeeze with rifle or pistol. (21; 6/6)

4. Breath Control:

This is important, but not as critical as with a rifle. (17; 8/2)

Always a factor in firing line of sight weapons. (19; 6/2)

5. Range Estimation:

Important for the effective utilization of the MG out to its maximum effective range of 1,100 meters. (17; 9/9)

D-13

I. TRAINING COMPONENTS (Cont'd)

5. <u>Range Estimation</u>: (Cont'd)

Range estimation is relatively easy to train, <u>if</u> it is trained.
Difficult at present. (18; 8/8)

This is always difficult to train. (19; 7/6)

Since an M60 MG is capable of engaging targets out to 1,100
meters, a soldier must be able to estimate range to <u>adjust</u> his
sights. (20; 8/6)

Range estimation is important because of trajectory and its
deviation from line of sight at ranges beyond 400 meters. Range
estimation becomes increasingly difficult at long ranges. (21; 7/9)

6. <u>Effects of Wind</u>:

This is not as critical as with a rifle due to size of beaten
zone and the fact that the soldier can observe the beaten zone and
adjust his fire. (17; 7/9)

Wind effects are difficult to train out to 1,100m and beyond.
(19; 7/8)

This is less important than with a rifle because of the size of
the beaten zone. (21; 6/8)

7. <u>Effects of Gravity</u>:

Gravity is more important than with a rifle due to firing over
extended range. (17; 9/6)

Same as #6 - difficult to train out to 1,100m and beyond.
(19; 7/8)

Effects of gravity and trajectory reference line of sight are
important in general terms (BASICS). (21; 3/7)

I. TRAINING COMPONENTS (Cont'd)

8. <u>Different Terrain</u>:

Training for the real world is important. (17; 7/9)

Minimal impact. (19; 5/2)

9. <u>Moving Targets</u>:

This is a real-world threat - not currently taught or tested.
(17; 9/9)

This is always an important criterion in any device. (19; 8/9)

As with the M16, we do not spend enough time on moving targets.
(20; 8/8)

10. <u>Misfire Frequency</u>:

Malfunction - a key skill required of a machinegunner in order
to keep the gun in action. (17; 9/6)

This may or may not be an important task. (19; 4/2)

It is extremely important to keep the MG functioning in combat.
Also, clearing a hot gun properly is extremely important in order to
prevent explosions and injuries. This is not emphasized enough.
(21; 9/5)

11. <u>Other</u>:

Tripod employment - most effective means of employing the M60,
facilitates grazing fire, final protective line, pre-determined fire
techniques. Techniques are different with the tripod vs. bipod.
(17; 9/6)

Observation of and adjustment of fire - most of the time it is
very difficult for the gunner. This is one reason an assistant
gunner should be employed with the MG. (17; 9/9)

D-15

M60 7.62mm General Purpose Machinegun (Cont'd)

I. TRAINING COMPONENTS (Cont'd)

   11. Other: (cont'd)

          Burst on target - use of tracers to burst on target - required

       for all crew served weapons systems. (19; 8/9)

          Beaten zone - this is an important concept that is difficult

       to get across to a soldier. (20; 8/9)

IV. IMPORTANT QUALITIES OF A SIMULATOR (Respondent No.; Rating)

   1. Realistic Sound:

          It may or may not have impact. (19; 7)

          It is nice to have realistic sound, but not necessary. (20; 4)

          It contributes or detracts little. (21; 1)

   2. Realistic Recoil:

          Being an automatic weapon, it is critical to learn steady hold

       on target. (18; 8)

          This should be demonstrated. (19; 8)

          In an M60 MG, this plays a big role in controlling the size of

       the beaten zone. (20; 7)

          It is essential in an automatic fire weapon to show effects of

       recoil on the location of bullet strikes. (21; 9)

   3. Misfire Capabilities:

          Assume that this will be trained on the real weapon. (17; 1)

          Can be taught in dry fire drills. (18; 3)

          Training misfire procedures with machineguns is a problem, given

       limited ammunition. (19; 6)

IV. IMPORTANT QUALITIES OF A SIMULATOR (Cont'd)

3. <u>Misfire Capabilities</u>: (cont'd)

This is very important, but maybe not for a simulator. This
training can be taught with the actual weapon & dummy ammo. (21; 5)

4. <u>Realistic Targets</u>:

Better to shoot at video of real targets. (17; 9)

Always a need. (19; 8)

The more realistic the targets, the more effective the training.
(20; 9)

Targets similar to standard U.S. Army E & F silhouettes are
adequate. (21; 7)

5. <u>Realistic Terrain</u>:

This aids in range estimation training. (18; 6)

Realistic terrain may or may not have impact. (19; 7)

Adds realism. (21; 6)

VI. IMPLEMENTATION (Respondent No.)

1. <u>Would a simulator fit into current instruction?</u>

Yes. (17)

Very likely. (18)

Yes - 5.56mm rounds for M249 - 7.62mm for M60 - .50 Cal. for
M2 are in short supply and this type of device would and could
sustain and maintain gunner proficiency for the MGs. (19)

In a company area, yes. Unless available in large numbers, it
would not work on a range. (20)

D-17

VI. IMPLEMENTATION (Cont'd)

2. <u>Would a simulator be used as a "free time" device?</u>

> Yes, if available. (17)

> Somewhat likely. (18)

> Yes - again in generic concept, this trainer would apply to a

wide range of weapons systems and have interchangeability of hardware.

(19)

> It should be. (20)

M249 5.56mm Squad Automatic Weapon (SAW)

I. TRAINING COMPONENTS (Respondent No.; Importance/Difficulty Rating)

1. Correct Sight Picture:

There should be much carry over from rifle marksmanship.
(17; 9/6)

As with the M16, correct sight picture is most important.
(20; 9/9)

2. Steady Position:

Holding properly throughout the burst is critical in order to
produce a beaten zone of effective size. (17; 9/6)

3. Trigger Manipulation:

The important factor here is to obtain a 6 to 9 round burst.
(20; 6/6)

Trigger manipulation is important in order to achieve the proper
number of rounds in a burst, but it is easier to teach on the SAW
than on the rifle or pistol. (21; 6/6)

4. Breath Control:

Beaten zone will compensate for minor errors. (17; 7/3)

5. Range Estimation:

It is important to use the weapon out to its maximum effective
range of 1,000 meters. (17; 9/9)

Since an MG is capable of engaging targets out to 1,000 meters,
a soldier must be able to estimate range to adjust his sights.
(20; 8/6)

Range estimation is important because of trajectory and its
deviation from line of sight at ranges beyond 400 meters. Range
estimation becomes increasingly difficult at long ranges. (21; 7/9)
D-19

M249 5.56mm Squad Automatic Weapon (SAW) (Cont'd)

I. TRAINING COMPONENTS (Cont'd)

6. Effects of Wind:

Important, but the spread of the beaten zone will allow some

compensating errors. (17; 7/7)

This is less important than with a rifle because of the size of

the beaten zone. (21; 6/8)

7. Effects of Gravity:

Gravity is important when using the weapon at distances out to

1,000 meters. (17; 9/7)

The effects of gravity and trajectory reference line of sight

are important in general terms (BASICS). (21; 3/7)

8. Different Terrain:

The appearance of different terrain and lighting conditions make

range estimation very difficult. (17; 9/9)

9. Moving Targets:

Needed - threat analysis engagement techniques not yet developed.

(17; 9/9)

As with the M16, we do not spend enough time on moving targets.

(20; 8/8)

10. Misfire Frequency:

It is extremely important to keep the MG functioning in combat.

Also, clearing a hot gun properly is extremely important in order to

prevent explosions and injuries. This is not emphasized enough.

(21; 9/5)

M249 5.56mm Squad Automatic Weapon (SAW) (Cont'd)

I. TRAINING COMPONENTS (Cont'd)

    11. Other:

        Assault fire – firing while moving is sometimes a tactical
necessity – however we don't teach it. (17; 9/9)

        Beaten zone – this is an important concept that is difficult
to get across to a soldier. (20; 8/9)

IV. IMPORTANT QUALITIES OF A SIMULATOR (Respondent No.; Rating)

    1. Realistic Sound:

        This would be nice to have, but not necessary. (20; 4)

        This contributes or detracts little. (21; 1)

    2. Realistic Recoil:

        This plays a big role in controlling the size of the beaten
zone. (20; 7)

        It is essential in an automatic fire weapon to show the effects
of recoil on the location of bullet strikes. (21; 9)

    3. Misfire Capabilities:

        If this learned with real weapon, then would not need to include
it in a simulator. (17; 2)

        This is very important, but maybe not for a simulator. This
training can be taught with the actual weapon & dummy ammo. (21; 5)

    4. Realistic Targets:

        The more realistic the targets, the more effective the training.
(20; 9)

        Targets similar to standard U.S. Army E & F silhouettes are
adequate. (21; 7)

IV. IMPORTANT QUALITIES OF A SIMULATOR (Cont'd)

  5. Realistic Terrain:

> Important because it adds realism. (21; 6)

VI. IMPLEMENTATION (Respondent No.)

  1. Would a simulator fit into current instruction?

> In a company area, yes. Unless available in large numbers, it would not work on a range. (20)

  2. Would a simulator be used as a "free time" device?

> It should be. (20)

M2HB .50 Caliber Heavy Machinegun

I. TRAINING COMPONENTS (Respondent No.; Importance/Difficulty Rating)

    1. Correct Sight Picture:

        No comments.

    2. Steady Position:

        This system is mounted. (20; 3/3)

        Steady position is provided by the gun mount. The soldiers

    should learn to use the mount. (17; 9/3)

    3. Trigger Manipulation:

        It is only important to obtain a 6 to 9 round burst. (20; 6/6)

        Trigger manipulation is important to achieve the proper number

    of rounds in a burst, but it is easier to teach on the .50 Caliber

    than on the rifle or pistol. (21; 6/6)

    4. Breath Control:

        Breath control does not affect this weapon system. (20; 1/1)

        This is a heavy gun. (17; 6/2)

    5. Range Estimation:

        The maximum effective range of the .50 Caliber is 1,860 meters,

    so range estimation is very important. (20; 8/6)

        Range estimation is important because of trajectory and its

    deviation from line of sight at ranges beyond 400 meters. Range

    estimation becomes increasingly difficult at long ranges. (21; 7/9)

    6. Effects of Wind:

        This is important only for long range fires. (20; 6/6)

        Wind effects are less important with the .50 Caliber than with a

    rifle because of the size of the beaten zone. (21; 6/8)

D-23

I. TRAINING COMPONENTS (Cont'd)

7. Effects of Gravity:

The effects of gravity and trajectory reference line of sight are important in general terms (BASICS). (21; 3/7)

8. Different Terrain:

No comments.

9. Moving Targets:

We need more training in this area. (20; 8/8)

10. Misfire Frequency:

Not important on this weapon system. (20; 3/3)

11. Other:

The vehicle-mounted .50 Caliber gun is fired by looking over the barrel and adjusting from the tracers and beaten zone. (17; 9/9)

IV. IMPORTANT QUALITIES OF A SIMULATOR (Respondent No.; Rating)

1. Realistic Sound:

Realistic sound is nice to have, but not important. (20; 3)

This contributes or detracts little. (21; 1)

2. Realistic Recoil:

This plays a big role in controlling the size of the beaten zone. (20; 7)

It is essential in an automatic fire weapon to show the effects of recoil on the location of bullet strikes. (21; 9)

3. Misfire Capabilities:

This is very important, but maybe not for a simulator. This training can be taught with the actual weapon & dummy ammo. (21; 5)

IV. IMPORTANT QUALITIES OF A SIMULATOR (Cont'd)

4. Realistic Targets:

The more realistic the targets, the better. (20; 9)

Targets similar to standard U.S. Army E & F silhouettes are

adequate. (21; 7)

5. Realistic Terrain:

This would add realism. (21; 6)

VI. IMPLEMENTATION (Respondent No.)

1. Would a simulator fit into current instruction?

Only if a large number were available on a range. (20)

2. Would a simulator be used as a "free time" device?

The size of the weapon might prohibit this. (20)

M203   40mm Grenade Launcher

I.   TRAINING COMPONENTS (Respondent No.; Importance/Difficulty Rating)

1. Correct Sight Picture:

I don't see how one of these devices could be used with the
M203 given its sight system. A problem with the sight system would
be adjusting the light pen on the quadrant sight. I would rather see
the funds that would be used to purchase this system used to buy more
ammo for the soldier to fire. (25; no rating)

2. Steady Position:

May or may not be important. (22; 4/2)

3. Trigger Manipulation:

May or may not have impact. (22; 5/4)

After rifle training, most issues are less critical. (32; 4/3)

4. Breath Control:

This can be learned. Breath control on an indirect weapon is
less of a problem than on a straight line of fire weapon. (22; 8/8)

5. Range Estimation:

This is very difficult for M203 without HE round. (22; 8/8)

This is the most significant factor, and the most difficult to
train. (24; 9/9)

Once learned, this is easy to apply. Usually a new firer works
onto a target using the location of the last round fired to make
range adjustments. (26; 7/7)

The round must fall within a 5m radius of the target to be
effective. Maximum effective range is 350m, but first round hits are
unlikely beyond 75m. The soldier must reload and fire again. (24; 9/9)

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I. TRAINING COMPONENTS (Cont'd)

6. Effects of Wind:

Wind is very critical with indirect fire or the lobbing effect

of this weapon. (22, 8/7)

7. Effects of Gravity:

Same as #6. (22, 8/7)

8. Different Terrain:

This becomes more critical than for line of sight weapons

because the M203 will be used to fire into dead space which cannot be

engaged by direct fire weapons. (22; 6/7)

Different terrain is important for simulating tactical employ-

ments. (26; 6/6)

9. Moving Targets:

Like playing submarine-torpedo video games. (26; 8/6)

10. Misfire Frequency:

May or may not be important. (22; 5/4)

11. Other:

No comments.

IV. IMPORTANT QUALITIES OF A SIMULATOR (Respondent No.; Rating)

1. Realistic Sound:

This may or may not be important. (22; 6)

The M203 launcher has "minimal" sound; doubtful importance on

any simulator. (24; 2)

2. Realistic Recoil:

Should be integrated into device. (22; 7)

IV. IMPORTANT QUALITIES OF A SIMULATOR (Cont'd)

 2. <u>Realistic Recoil</u>: (cont'd)

  Recoil is not a critical problem; accuracy is affected more by

 range estimation, and not so much by the ability to hit the target at

 an estimated range. (24; 4)

 3. <u>Misfire Capabilities</u>:

  I don't know the consequences of this happening. (24; 3)

 4. <u>Realistic Targets</u>:

  Always important. (22; 7)

 5. <u>Realistic Terrain</u>:

  May or may not have an impact. (22; 6)

  This is important only from the perspective of ranging. (24; 4)

  Grade and elevation affect range estimation; therefore,

 realistic terrain may be useful training for simulation. (26; 8)

VI. IMPLEMENTATION (Respondent No.)

 1. <u>Would a simulator fit into current instruction?</u>

  Yes. (22)

  Yes. (23)

  Yes, but more in units than on a range. There are too many

 soldiers and too little time on a range. (24)

  No. (25)

  I doubt it. (26)

 2. <u>Would a simulator be used as a "free time" device?</u>

  Trainers will <u>not</u> be provided sufficient HE rounds to effectively

 maintain/sustain weapons proficiency on the M203. This is why the

VI.   IMPLEMENTATION (Cont'd)

2.   <u>Would a simulator be used as a "free time" device?</u> (cont'd)

video trainer would assist. Also units with range restrictions (RC

and AC) make it imperative that we come up with a video trainer. (22)

Yes. (23)

Definitely. (24)

No. (25)

M202A1 66mm Incendiary Rocket Launcher (FLASH)

I. TRAINING COMPONENTS (Respondent No.; Importance/Difficulty Rating)

1. Correct Sight Picture:

    The soldier must put sight reticle on center mass of target.
    (27; 9/5)

2. Steady Position:

    The soldier must have a good steady position when firing the
    Flash since it rests on the shoulder. It can be fired from a foxhole
    with the back blast area cleared. (27; 9/7)

3. Trigger Manipulation:

    No comments.

4. Breath Control:

    One normally does not breathe during the firing of this weapon.
    (27; 9/6)

5. Range Estimation:

    No comments.

6. Effects of Wind:

    It is hard to determine the effects of wind on the firing ranges
    due to the inconsistency of wind. The wind would have a great effect
    on firing in a standing position due to the instability of position.
    (27; 8/9)

7. Effects of Gravity:

    No comments.

8. Different Terrain:

    No comments.

M202A1 66mm Incendiary Rocket Launcher (FLASH) (Cont'd)

I.   TRAINING COMPONENTS (Cont'd)

   9. Moving Targets:

         Most of the gunner's targets will probably be stationary or
   very slow moving. (27; 6/8)

   10. Misfire Frequency:

         This is covered by SOP and mechanical training. (27; no rating)

   11. Other:

         No comments.

IV. IMPORTANT QUALITIES OF A SIMULATOR (Respondent No.; Rating)

   1. Realistic Sound:

         The Flash has the same sound as the old 3.5 Rocket Launcher.
   (27; 9)

   2. Realistic Recoil:

         This weapon does not have very much recoil; probably about like
   the LAW. (27; 6)

   3. Misfire Capabilities:

         No comments.

   4. Realistic Targets:

         No comments.

   5. Realistic Terrain:

         No comments.

VI. IMPLEMENTATION (Respondent No.)

   1. Would a simulator fit into current instruction?

         No comments.

   2. Would a simulator be used as a "free time" device?

         No comments.

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Light Antitank Weapon (LAW)

I. TRAINING COMPONENTS (Respondent No.; Importance/Difficulty Rating)

1. Correct Sight Picture:

    No comments.

2. Steady Position:

    No comments.

3. Trigger Manipulation:

    No comments.

4. Breath Control:

    No comments.

5. Range Estimation:

    Training in range estimation presently is poor. (28; 9/9)

6. Effects of Wind:

    No comments.

7. Effects of Gravity:

    No comments.

8. Different Terrain:

    Relates to accurate range estimation. (28; 3/2)

9. Moving Targets:

    Video game would be an easy simulation for LAW/VIPER. (28; 9/8)

10. Misfire Frequency:

    No comments.

11. Other:

    No comments.

IV. IMPORTANT QUALITIES OF A SIMULATOR (Respondent No.; Rating)

1. Realistic Sound:

    No comments.

IV. IMPORTANT QUALITIES OF A SIMULATOR (Cont'd)

2. <u>Realistic Recoil</u>:

No comments.

3. <u>Misfire Capabilities</u>:

No comments.

4. <u>Realistic Targets</u>:

Both points (#4 and #5) are keys to range estimation to determine

effective engagement range. Both are very important. (28; 9)

5. <u>Realistic Terrain</u>:

Both points (#4 and #5) are keys to range estimation to determine

effective engagement range. Both are very important. (28; 9)

VI. IMPLEMENTATION (Respondent No.)

1. <u>Would a simulator fit into current instruction</u>?

Most definitely, these are high cost, live fire weapons. Dry

fire drill does not prepare the firer for launch. (28)

2. <u>Would a simulator be used as a "free time" device</u>?

No comments.

Dragon

I.   TRAINING COMPONENTS (Respondent No.; Importance/Difficulty Rating)

   1. Correct Sight Picture:

      The soldier must keep the sight reticle on target at all times
      after the round is fired to achieve target hit. This is not hard to
      teach, but hard to achieve. (29; 9/9)

      This only becomes difficult during launch transition of a
      tactical round. (30; 3/4)

   2. Steady Position:

      The soldier must maintain the weapon as steady as possible
      during firing and after firing. The LET is presently used to help
      teach steady hold. (29; 9/9)

   3. Trigger Manipulation:

      No comments.

   4. Breath Control:

      The Dragon round will move a certain degree each time you breathe.
      (29; 9/9)

      Breath control is a factor with any system that requires
      tracking sequence after launch. (30; 5/5)

   5. Range Estimation:

      This must be learned through experience and trial and error.
      (29; 9/9)

      This is always a difficult task with all weapons systems.
      (30; 8/9)

   6. Effects of Wind:

      As long as the gunner can hold his sights on the target, he
      will achieve a target hit. (39; 5/7)

Dragon (Cont'd)

I. TRAINING COMPONENTS (Cont'd)

7. Effects of Gravity:

No comments.

8. Different Terrain:

No comments.

9. Moving Targets:

This is probably the hardest part of teaching a gunner due to the instability of firing positions, plus the weapon being on the shoulder. (29; 9/9)

Moving targets are only difficult if gunner cannot survive the launch transition. (30; 1/4)

10. Misfire Frequency:

Procedures are outlined in TASK - condition - standard. (30; 1/4)

11. Other:

Loss of weight shift - upon launch, the rocket exiting the tube throws the tube upward if not firmly held down by the gunner. (30; 9/9)

IV. IMPORTANT QUALITIES OF A SIMULATOR (Respondent No.; Rating)

1. Realistic Sound:

Must have realistic sound and simulated back blast as well as weight shift and smoke obscuration. (29; 9)

Device must replicate actual launch transition of 185 db. (30; 8)

2. Realistic Recoil:

Without recoil, you could not really determine how much effect it would have on correcting the missile immediately after leaving the launcher. (29; 9)

IV. IMPORTANT QUALITIES OF A SIMULATOR (Cont'd)

    2. <u>Realistic Recoil</u>: (cont'd)

        Must have weight shift and loss of 13.1 lb rocket exiting
the tube upon launch. (30; 9)

    3. <u>Misfire Capabilities</u>:

        Soldier should know, but this is taught as part of mechanical
training and covered by unit SOP. (29; 5)

        Although this is a task, it doesn't need to be trained. (30; 2)

    4. <u>Realistic Targets</u>:

        Should be similar type targets the Dragon would engage including
frontal, oblique, side, and rear type targets. (29; 9)

        Must have a capability to portray actual targets for both day
and night (thermal views). (30; 8)

    5. <u>Realistic Terrain</u>:

        This is important, but the first four are more important. Once
a gunner masters firing and tracking, he should be able to use the
Dragon to its maximum capabilities in the terrain it was designed to
be fired in since it is a guided wire type weapon. (29; 7)

        May or may not be important. (30; 6)

VI. IMPLEMENTATION (Respondent No.)

    1. <u>Would a simulator fit into current instruction?</u>

        It would provide anti-armor gunnery qualification device
for Dragon. (30)

        Low quality simulators are already used. PM-Trade is developing
a better one, too. (31)

VI. IMPLEMENTATION (Cont'd)

2. <u>Would a simulator be used as a "free time" device?</u>

Yes. It could be used as an indoor trainer given a

dedicated trainer (master trainer) to operate device's

instructor/critique station. (30)

Probably not. Dragon too onerous. (31)

I.   TRAINING COMPONENTS (Respondent No.; Importance/Difficulty Rating)

   1.   <u>Correct Sight Picture</u>:

       TOW is a very good system. Sight picture only becomes a problem on moving targets. (30; 7/2)

   2.   <u>Steady Position</u>:

       TOW systems maintain reliability. (30; 5/1)

   3.   <u>Trigger Manipulation</u>:

       No comments.

   4.   <u>Breath Control</u>:

       No comments.

   5.   <u>Range Estimation</u>:

       Range estimation training is needed for all weapons systems. (30; 8/7)

   6.   <u>Effects of Wind</u>:

       No comments.

   7.   <u>Effects of Gravity</u>:

       No comments.

   8.   <u>Different Terrain</u>:

       No comments.

   9.   <u>Moving Targets</u>:

       Moving targets are hard to hit and the probability of a hit drops from .92 to .75. Add the moving target in evasive measures, and the hit probability drops further. (30; 9/8)

  10.   <u>Misfire Frequency</u>:

       No comments.

I. TRAINING COMPONENTS (Cont'd)

11. Other:

Thermal training - be able to recognize/identify targets out to 3750 meters based on thermal cues of the target. No training in the Army for thermal training. (30; 8/9)

IV. IMPORTANT QUALITIES OF A SIMULATOR (Respondent No.; Rating)

1. Realistic Sound:

Although somewhat less than Dragon, the sound of the TOW is still loud, approximately 170 db. (30; 7)

2. Realistic Recoil:

Very minimal. (30; 2)

3. Misfire Capabilities:

Not applicable. (30; 1)

4. Realistic Targets:

Very important - both day and night at 3750m. (30; 8)

5. Realistic Terrain:

This may or may not be important, but should be given consideration. (30; 5)

VI. IMPLEMENTATION (Respondent No.)

1. Would a simulator fit into current instruction?

Most definitely, these are high cost, live fire weapons. Dry fire drill does not prepare firer for launch. (28)

Yes - both at institution and unit for reserve and active units. (30)

2. Would a simulator be used as a "free time" device?

Yes. (30)

M29A1 81mm and M30 4.2 in Mortars

I.   TRAINING COMPONENTS (Respondent No.; Importance/Difficulty Rating)

   1. Correct Sight Picture:

       Gunner has sufficient training time to align sights with aiming

   posts. (36; 4/3)

   2. Steady Position:

       No comments.

   3. Trigger Manipulation:

       No comments.

   4. Breath Control:

       No comments.

   5. Range Estimation:

       FIST Team (observers) need extensive training in range esti-

   mation. (44; 9/8)

   6. Effects of Wind:

       Computed. (36; 9/8)

   7. Effects of Gravity:

       This is covered in theory portion of training. (36; 2/1)

   8. Different Terrain:

       Reference range estimation on different terrain. (36; 9/8)

   9. Moving Targets:

       This applies to the FIST team learning to call for fire quickly.

   (36; 4/3)

   10. Misfire Frequency:

       No comments.

   11. Other:

       No comments.

M29A1 81mm and M30 4.2 in Mortars (Cont'd)

IV. IMPORTANT QUALITIES OF A SIMULATOR (Respondent No.; Rating)

1. Realistic Sound:

Not very important because in combat, battlefield noises are not usually present. (35; 3)

2. Realistic Recoil:

No comments.

3. Misfire Capabilities:

No comments.

4. Realistic Targets:

For FO training. (36; 9)

5. Realistic Terrain:

For FO training. (36; 9)

VI. IMPLEMENTATION (Respondent)

1. Would a simulator fit into current instruction?

FO – yes, FDC – possible, Gunnery – no. (32)

For FDC only. As shown, it will not work with mortars. Using computers to train the FDC would be great. The computer gives the FDC a call for fire, the data are computed and put into the computer, the computer would show the impact of the round in relation to the target, and then come back with a correction. (34)

Maybe in a learning center environment. (35)

I don't feel that a simulator is feasible for mortars. (35)

Simulation may be useful to further enhance observer training. An area where training falls short is fire mission computer training and procedural practice. The skills are fragile and should be

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VI. IMPLEMENTATION (Cont'd)

1. <u>Would a simulator fit into current instruction</u>? (cont'd)

exercised frequently. Currently, this is the only identifiable void

in mortar training which cannot be filled simply by using available

resources. (36)

2. <u>Would a simulator be used as a "free time" device</u>?

Yes. (32)

Yes, if located at battalion level Individual Learning Center.

(41)

Not likely! (34)

Not very often. (35)